MECHANICAL BROADHEAD WITH SLIDING BLADES

FIELD OF THE INVENTION

[0001] The present invention relates generally to mechanical or expanding-blade broadheads, and more particularly to a mechanical broadhead in which the blades slide within a longitudinal channel formed in the ferrule.

BACKGROUND OF THE INVENTION

[0002] A mechanical or expanding-blade broadhead is a type of broadhead in which the blades are operably coupled to the ferrule in a manner to move from an in-flight, retracted position to an on-impact, deployed position. This configuration of a broadhead is beneficial in that it has flight characteristics similar to those of a field point tip and penetration characteristics similar to those of a fixed blade broadhead.

[0003] The most popular type of mechanical broadhead has one or more blades located within a slot such that the cutting edge is on the radially inward edge of the blade. The blade is pivotally coupled to the rearward portion of the ferrule so that it may rotate from a retracted position to a deployed position about the pivot on impact within a target, thereby exposing the cutting edge formed on the blade. This type of mechanical broadhead has performed with varying degrees of success. However, substantial kinetic energy is required to rotate the blade about the pivot from the retracted position to the deployed

position. As a result, less kinetic energy is available for target penetration on impact.

[0004] Another less-common type of mechanical broadhead includes one or more blades which longitudinally slide relative to the ferrule from the in-flight, retracted position to the on-impact deployed position. Specifically, the blades in this sliding-type mechanical broadhead are disposed within a longitudinal groove formed in the ferrule such that the cutting edge of the blades extend radially outwardly. A lost-motion slot is formed in the interior of the blade and receives a pin extending through the ferrule to operably couple the blade thereto. During flight, the blades are closely positioned to the ferrule, and upon impact the blades slide rearwardly through a range of motion defined by the slot to the deployed position.

[0005] The sliding-type mechanical broadhead are in principle better than the pivoting-type mechanical broadheads in that they require less kinetic energy to move the blades from the retracted position to the deployed position. However, the current designs of such broadheads are less robust than other types of mechanical broadheads. Specifically, a ferrule in a sliding-type broadhead is typically fabricated from an aluminum alloy due to the required geometric complexity. Furthermore, the slot formed in the blades reduces the overall stiffness and durability thereof.

[0006] Recent developments in the broadhead art, and in particular use of powder injection molding for the manufacture of components, have added significant flexibility in the design and manufacture of broadheads. This

manufacturing technology allows a broadhead designer to make fine details and features as integral parts of the broadhead component. Furthermore, this technology enables design features such as a tapered blade to be utilized.

SUMMARY OF THE INVENTION

[0007] The present invention is directed to a mechanical broadhead in which a set of blades are operably coupled to the ferrule to slide within a longitudinal channel formed therein from an in-flight, retracted position to an on-impact deployed position. Specifically, each blade has a boss extending from a flank of the blade. The channel formed in the ferrule is complimentary with the boss such that the blade freely slides within the channel. A lip formed on the surface of the ferrule at the channel captures and retains the blade within the ferrule while permitting the desired relative sliding movement. A collar or insert such as that used within the end of an arrow shaft is positioned at the rearward face of the ferrule. The collar functions to retain the blades within the channel and to provide a cam upon which the blade is moved radially outward in coordination with the longitudinal sliding movement.

[0008] In one aspect, the present invention is directed to a sliding-type mechanical broadhead in which the blades of the broadhead have a boss extending transversely from a flank of the blade which is received within a channel formed in the ferrule to opearbly couple the blade to the ferrule.

[0009] Another aspect of the present invention is directed to a sliding-type mechanical broadhead in which the blade, and more particularly the

rearward end of the blade has a improved path of travel with an initial movement which is substantially parallel to the longitudinal axis of the channel formed in the ferrule prior to sliding rearwardly and rotating outwardly during the balance of the blade travel.

[0010] A further aspect of the present invention is to provide an improved design for a sliding-type mechanical broadhead in which the blades may be readily replaced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

[0012] Figure 1 is a top view of a mechanical broadhead in accordance with a first preferred embodiment of the present invention with the blades shown in a retracted position;

[0013] Figure 2 is a side view of the broadhead illustrated in Figure 1 with the blades shown in solid lines in the retracted position and broken lines in the deployed position;

[0014] Figure 3 is a transverse cross-section taken along line III-III shown in Fig. 2;

[0015] Figure 4 is a side view of a blade shown in Figure 2;

[0016] Figure 5 is a cross-section of the broadhead of Figure 1 in which the blades are shown in the retracted position;

[0017] Figure 6 is a cross-section similar to Fig. 5 in which the blades are shown in a partially deployed position;

[0018] Figure 7 is a cross-section similar to Fig. 5 in which the blades are shown in the fully deployed position;

[0019] Figure 8 is an exploded perspective view of a mechanical broadhead in accordance with a second preferred embodiment of the present invention;

[0020] Figure 9 is a transverse cross-section taken through the blade at the boss;

[0021] Figure 10 is a side view of the blade shown in Figure 8;

[0022] Figure 11 is a cross-section of the broadhead of Figure 8 in which the blades are shown in the retracted position;

[0023] Figure 12 is a side view of a mechanical broadhead in accordance with a third preferred embodiment of the present invention in which the upper blade is shown in a retracted position and the lower blade is shown in a deployed position; and

[0024] Figure 13 is a cross-sectional of the broadhead of Figure 12.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0025] With reference to the Figures, a first preferred embodiment of the present invention is illustrated in Figures 1-7, a second preferred embodiment of the present invention is illustrated in Figures 8-10 and a third preferred embodiment is illustrated in Figures 12 and 13. Unless specifically noted, it will

be understood that the three preferred embodiments share the same of similar features. The present invention is directed to a mechanical broadhead 10 having multiple blades 12 operably coupled to a ferrule 14 such that the blades 12 slide within a channel 16 formed longitudinally in the ferrule 14. Blades 12 are slidably positionable within channel 16 from an in-flight, retracted position to an on-impact, deployed position. The broadhead 10 is secured to an arrow shaft 18 through insert 20. As presently preferred, ferrule 14 has a shank portion 22 with an external thread formed thereon for releasably securing the ferrule 14 to the insert 20. A tip portion 24 is formed on the ferrule 14 opposite the shank portion 22 to provide a cutting edge for broadhead 10. As illustrated in the figures, tip portion 24 is integral with the body of the ferrule 14. Tip portion 24 is a hybrid tip having a tapered nose with a pair of fixed cutting blades 26 extending laterally from the ferrule 14. While the present invention is illustrated with a hybrid tip, one skilled in the art will recognize that a mechanical broadhead in accordance with the present invention could be provided with a variety of tip portions such as a trocar point or a conventional field point.

[0026] With reference now to Figures 3-4 and 9-10, each of the blades 12 have a generally planar flank portion 28 and a tapered edge portion 30 terminating at a sharpened edge. A boss 32 extends transversely from the planar flank 28 and is received within channel 16 to operably couple the blades 12 with the ferrule 14. Channel 16 is configured to be complementary with the boss 32. Channel 16 has a geometry which is generally complementary of the boss 32 and a lip 36 which cooperates with the boss 32 to retain the blade 12 in

the ferrule 14. The boss 32 and a portion of the blade flank 28 are received within the channel 16. In the first embodiment, the insert 20 located adjacent the ferrule 14 functions as a collar to retain the boss 32 within the channel 16 as best seen in Figure 2. In the second embodiment as illustrated in Figures 8 and 11, a retainer clip 34 is located over the shank portion 22 of the ferrule 14 and functions as the collar. In particular, the retainer clip 34 has a pair of ramped elements 38 which extend into the channels 16 to retain the blades 12 within the ferrule 14. The remaining portion of the blade flank 28 and the edge portion 30 extend outwardly through channel 16 from ferrule 14.

[0027] To facilitate sliding of the blade 12 relative to the ferrule 14, the height (x-direction) and width (y-direction) increase along the length (z-direction) from the tip 24 to the shank 22. In this manner, the channels 16 expand slightly in height and in width from a leading end to a trailing end of the ferrule 14 such that the blades 12 slide more freely as they move rearwardly. A relief in the form of an angular relief, a linear relief or a radial relief may also be provided on the lip 36 to promote free sliding movement of the blades 12 within the channels 16.

[0028] As best seen in Figures 3 and 8-9, the boss 32 is configured as a hemispherical extension which provides a smooth interface within the channel 16 which has a generally elliptical groove. However, one skilled in the art will recognize that the configuration of the boss 32 and the channel 16 may take any suitable form which provides a smooth interface to promote relative sliding movement therebetween.

[0029] With particular reference to Figures 4 and 10, each blade 12 has a camming surface 42 formed on the blade opposite edge portion 30. A forward portion 42a of the camming surface cooperates with the channel 16 to control the cutting diameter (i.e., the distance between the rear tips of the blades 12) in the deployed position. A rearward portion 42b of the camming surface 42 extending rearwardly of the boss 32 cooperates with the collar (defined by the insert 20 in the first embodiment and the ramped elements 38 in the second embodiment) to rotate the blades 12 outwardly as they slide longitudinally rearwardly within the ferrule 14. Thus, the forward and rearward portions 42a, 42b of the camming surface define a blade travel path 44.

[0030] As presently preferred the geometry of the blades 12 is such that travel within the channel 16 is initially generally parallel to the longitudinal axis A-A of channels 16 formed in the ferrule 14 until the rear camming surface 42b engages the collar. At this point the camming surface 42b engages the collar such that the blades 12 rotate outwardly as they slide rearwardly in channel 16. The blade travel path described above is illustrated with phantom lines in Figure 2 and will be more fully appreciated from a comparison of Figures 5-7 showing the blades 12 retracted, partially deployed and fully deployed, respectively.

[0031] The blades 12 may include other features to enhance the functions of the mechanical broadhead. With reference to the first preferred embodiment, notch 46 may be formed at the end of forward camming portion 42a and functions to limit the blades 12 ability to pivot about the boss 32 when in the

retracted position. For example, as best seen in Figure 5, the notch 46 engages the tip portion 24 of the ferrule 14 to achieve this limiting function. One skilled in the art will recognize that the edge portion 30 of the blades 12 are configured to provide sufficient frontal area to engage a target upon impact and initiate the rearward movement of the blades 12 relative the ferrule 14. With reference to the second preferred embodiment, a detent 42c may be provided in camming surface 42 to enhance blade retention in the in-flight retracted position as hereinafter described. The blades 12 may also be provided with pockets 44 (or alternatively with windows, not shown) such that the weight and rotational inertia of the blade may be precisely tuned.

[0032] A retainer may be utilized to selectively retain the blades in the in-flight retracted position. With reference now to Figures 5-7, the first preferred embodiment includes a compliant element 48 disposed within the channels 16 of the ferrule 14. Compliant element 48 functions as friction point within the channel 16 to lightly retain the blades 12 in the in-flight, retracted position. As presently preferred, the compliant element 48 is formed from rubber or urethane and provides slight resistance to rearward sliding movement of the blades 12 in the channel 16. With reference to the second preferred embodiment, the retainer clip 34 includes legs 50 located in respective grooves 52 formed in channel 16 as best seen in Figure 9. A bump 54 is formed at the forward end of legs 50 to slightly extend from groove 52 into channel 16. Bump 54 cooperates with detent 42c formed in camming surface 42 for temporarily retaining the blade 12 in the in-flight retracted position. Retainer clip 34 is made of a resilient material such

that bump 54 may be elastically deformed when the blades 12 impact a target, thus initiating rearward movement of the blades 12.

[0033] With now reference to Figures 12 and 13, a third preferred embodiment is illustrated which utilizes an O-ring 56 located concentrically about the ferrule 14 to releasably retain the blades 12 in the in-flight, retracted position. The O-ring 56 is retained in the groove 58 in the ferrule 14. A hook configuration 60 is formed at the rearward bottom portion or tail of the blade 12 as shown in Figure 13. As presently preferred, the O-ring is a rubber or other suitable material with sufficient elasticity to releasably retain the blades 12 in the retracted position. The blades 12 are first assembled to the ferrule 14 by inserting the bosses 32 into their respective channels 16. The O-ring 56 is then slipped over the ferrule 14 and positioned in the retaining groove 58 in the ferrule 14. The hook 60 on the blades 12 are engaged with the O-ring 56. Upon impact, the rearward motion of the blades 12 disengages the O-ring 56 allowing the blades 12 to deploy following the travel path generally illustrated in Figure 2.

[0034] The design of the broadhead components, and in particular the ferrule 14 readily lends itself to manufacture utilizing a powder injection molding process. Specifically, the geometric configuration of the channel 16 and the integral features of tip portion 24 are features which may be readily formed utilizing powder injection molding technology. In this regard, U.S. Patent No. 6,290,903 and U.S. Patent No. 6,595,881 disclose further details regarding preferred powder injection molding processes for broadheads and broadhead components, the disclosures which are expressly incorporated by reference

herein. Additional features, such as scallops formed in the outer surface of the ferrule 14 and the rearwardly expanding channel 16 may be readily included in the design of the present invention. Likewise, the design of the blades 12 and in particular the boss 32, the tapered cross-section of the blade and the pockets (or windows) lends themselves to fabrication utilizing the powder injection molding process.

[0035] As noted above, the preferred embodiment of the present invention is illustrated to include a pair of blades 12 operably coupled to the ferrule 14 for sliding movement between the retracted and expanded positions. However, one skilled in the art will readily recognize that the present invention may be readily adapted to provide a broadhead having a configuration with any number of multiple blades as dictated by the specific application. Likewise, a particular design and shape of the ferrule including the tip portion may be modified as dictated by the specific application. For example, as the embodiment illustrated in the drawings presently contemplates an 85 grain broadhead; however, the ferrule 14 may be reconfigured to provide a generally tapered ferrule without the scallops to provide a 100 grain broadhead. The present invention has been described with reference to two preferred embodiments having many common and some distinct features. One skilled in the art will recognize that these features may be used singularly or in any combination based on the requirements and specifications of a given application or design.

[0036] The description of the invention is merely exemplary in nature and, thus, variations that do not depart from the gist of the invention are intended to be within the scope of the invention. Such variations are not to be regarded as a departure from the spirit and scope of the invention.